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Sustainability for maize production under organic farming system.

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Introduction-

Maize (*Zea mays* L.) is one of the most versatile emerging crops having wider adaptability under varied agro-climatic conditions. Globally, maize is known as queen of cereals because it has the highest genetic yield potential among the cereals. It is cultivated on nearly 190 m ha in about 165 countries having wider diversity of soil, climate, biodiversity and management practices that contributes 39 % in the global grain production. The United States of America (USA) is the largest producer of maize contributes nearly 36% of the total production in the world and maize is the driver of the US economy. In India, Maize is grown throughout the year. It is predominantly a Kharif crop with 85 per cent of the area under cultivation in the season. Maize is the third most important cereal crop in India after rice and wheat. It accounts for around 10 per cent of total food grain production in the country. In addition to staple food for human being and quality feed for animals, maize serves as a basic raw material as an ingredient to thousands of industrial products that includes starch, oil, protein, alcoholic beverages, food sweeteners, pharmaceutical, cosmetic, textile, gum, package and paper industries etc.

Achieving grain supply security with limited arable land is a major challenge in the twenty-first century, owing to the changing climate and increasing global population. Maize plays an increasingly vital role in global grain production. As a C4 plant, maize has a high yield potential. Maize is predicted to become the number one cereal in the world by 2030. However, maize production has reached at plateau in many countries, and hybrid and production technologies have been fully exploited. Thus, there is an urgent need to shape maize traits and architectures for increased stress tolerance and higher yield in a

changing climate for sustainable production. Organic farming for maize production can help to achieve this target of sustainable production.

Organic farming is not a new concept to Indian farmers, because they have practiced it since ancient times. Organic farming system relies on crop rotation, crop residues, animal manures, legumes, green manures, off- farm wastes and biological pest control. Yields in organic farming are lower than chemical farming during initial years of practice and it takes a few years to stabilize the yields .However, in the long run, if properly followed ,yield with organic farming would be a greater than those obtained with chemical farming . The gravity of environmental degradation has drawn the attention of the scientists and planners towards finding out ecologically sound, viable and sustainable farm technologies, keeping in view of the needs of the future generations. Most of the Indian soils contain less than 0.5 per cent organic carbon. Unless it is raised to 0.9 – 1 per cent level, productivity of the soil cannot be optimized. In view of the resurgence of interest in alternative agriculture in recent years, organic farming has been considered to be sound and viable option in most of the countries.

The term agriculture derived from a *Latin* word that means both crop plants and domestic animals and their products to benefit the human kind. The production and productivity were increased during the time of green revolution due to the use of high yielding seed, fertilizer, irrigation facilities and chemicals for control of diseases and pests. But due the continuous use of high dose of fertilizers and chemicals for getting much higher yield, crop may remain the residual effect that may cause the different issues in animals as well as human beings. Now the era is shifting from chemical or fertilizers based agriculture to organic agriculture. In India the Sikkim state declared as organic farming state, they are not using single chemicals in their crops. Even though the crop yield under organic condition is low but that will be compensate by getting higher price of organic crops compared to traditional crops. In this context, breeders planned to do some breeding activities for organic condition or to develop the varieties for organic condition to get higher yield i.e. organic plant breeding. Organic plant breeding is important for farmers and human health because it do not affect the environment and human health. In which, control of inorganic and synthetic chemicals such as pesticide and insecticide, synthetic soluble fertilizers and veterinary medicines, organic farmers rely heavily on preventive and system-oriented practices. Varieties developed through

organic plant breeding and multiplication of seed production through use of organic plant breeding.

The worldwide umbrella organization International Federation of Organic Agriculture Movements (IFOAM) defined to organic agriculture, organic agriculture is a production system in which scientists and plant breeder consider high yield, without losing effect of soil health, people and ecosystem, biodiversity and their components and without using of in-organic chemicals, synthetic chemicals and pesticide etc. Organic farming produce lower yield than conventional breeding but it is more eco-friendly, profitable for human health and provides good nutritional value to human diet.

Sustainable

Modern Concept of Organic Farming-

The modern concept of organic farming combines the tradition, innovation and science. Although, history states that the movement for organic way of life recognized in 1905, it could gain ground after realizing the ill effects of modern agriculture in the late 1990's. In 1905, the British botanist Sir Albert Howard, often referred to as the father of modern organic agriculture, documented traditional Indian farming practices, and came to regard them as superior to conventional agriculture science. During 1940, In Japan, Masanobu Fukuoka, a microbiologist working in soil science and plant pathology, quit job as a research scientist, returned to his family's farm, and devoted the next 30 years to develop a radical no-till organic method for growing grain, now known as "*Fukuoka farming*". Many other practices such as Rishi krishi, Natueco farming, homa farming, panchagavya krishi and bio dynamic farming are associated with organic agriculture. The reports indicates organic farming can minimize energy consumption by 30.7 % per unit of land by eliminating the energy required to manufacture synthetic fertilizers and pesticides and by using internal farm inputs, thus reducing fuel used for transportation. India can emerge as global leader due to the presence of large number of organic producers (almost 7 lakh producers) and they needs to be supported with technical knowledge and inputs besides marketing infrastructure. The research results available for little over a decade confirms the yield advantage in many crops such as basmati rice, maize, cotton, chickpea, soybean, groundnut etc.

However, the major impediment for growth of organic farming in India is yield reduction in the initial years due to swift switch over from inorganic to organic, wide gap between availability of organic source of nutrients and requirement and lack of pest and disease management options. Most of the organic growers have expressed that lack of support price for organically grown crops and marketing infrastructure as the major constraint in promotion of organic agriculture. The certification systems of grower group, participatory guarantee system, know your farm and know your food should be promoted in large scale.

Status of Organic Farming-

Demand for organic products, especially in developed countries, has been increasing since start of this century. Globally, organic agriculture is practiced in 162 countries and 37 m ha of land are managed organically by 1.8 million farm households. The regions with the largest areas of organically managed agricultural land are Oceania (12.1 million hectares of 33 percent of the global organic farmland), Europe (10.6 million hectares or 29 percent of the global organic farmland) and Latin America (6.8 million hectares or 23 percent). On a global level, the organic agricultural land area increased by three percent compared with 2010. The countries with the most organic agricultural land are Australia (12 million hectares), Argentina (3.8 million hectares) and the United States (1.9 million hectares). In Asia, land under organic management reached 3.6 million hectares for 2009 up from just under 3.4 million hectares reported for 2008 and under 2.9 million hectares for 2007. The expansion of over 0.2 million hectares, a growth rate of close to 6 per cent comes on top of a 17 per cent growth from 2007 to 2008. It maintains an upward trend albeit a slower pace of conversion. The main contributor of the expansion of cultivated acreage is India. With the increasing awareness about the safety and quality of foods, long term sustainability of the system and accumulating evidences of being equally productive, the organic farming has emerged as an alternative system of farming which not only addresses the quality and sustainability concerns, but also ensures a profitable livelihood option. Cultivated area under certified organic farming has grown almost 17 fold in last one decade.

Plant breeding for organic farming-

Organic plant breeding is a system that develops the variety which is higher yielder under organic conditions which maintain the soil and human being health due to non application of

chemicals. Eventually the yield of organic variety may be low but that can be addressed through the use of plant breeding techniques under organic soil. The varieties developed through organic plant breeding or varieties cultivated under organic conditions may not have any adverse effect on human health and even familiar to environment also. The next decade may be the era of organic breeding activities and organic agriculture without any yield barrier and other challenges that we are facing in present scenario.

The breeding goals for organic agriculture to get high yield as compared with conventional breeding methods. Incorporation of resistance genes and tolerance genes to biotic and abiotic factors and higher resource efficiency for plant (water, nutrients and light etc.) organic plant breeding aims to fit any variety for any environment and for any farming system. The variety affected by the variable environments and specific variety cannot exist in variable environment. So, we will make effort to develop such variety which is adaptable to every environment. In general, crossing methods that do not break the reproductive barriers between species and selection methods based on the evaluation and selection of whole plant performance. There are some breeding techniques to develop high yielding variety through organic plant breeding e.g., 1. Intraspecific crossing (2) backcrossing (3) mass and individual selection (4) hybrid cultivars, without harassment of any gene, transfer of desirable genes from wild germplasm/accession or landraces to modern cultivar. Development of varieties fit for organic farming can be achieved successfully if plant breeding programs combine the selection of the progeny in organic and low-input environments. In organic plant breeding we can use system of shuttle breeding in which segregating materials differentiate in different environment to achieve wide adaptation for insect and disease resistance.

Challenges for organic plant breeding-

Organic plant breeding is not a strategy but it excluded to those techniques which are being hazard for ecological perspective and attention to bring to take about improvement of organic varieties which is suitable for all beneficiary. There are some precious challenges for organic plant breeding which are given below.

1. Main challenge to obtain new variety with organic plant breeding: it is difficult task that any variety developed through organic plant breeding does not adapted to every environment.

2. Low yield in comparison to conventional breeding method: it is demonstrated that organic plant breeding gives low yield compression to conventional breeding method, because in organic plant breeding we cannot use any chemical substances which affect the yield of a variety. But in conventional breeding continuing use of chemical fertilizer which make to get higher yield from any variety.
3. To control insect-pest in organic plant breeding is difficult task, there are many insect pest out of which is being harmful for organic plant breeding because in organic plant breeding, we cannot utilize any synthetic chemicals, organic chemicals, pesticide and insecticide. In organic plant breeding we can use only those products which are synthesized from organic products to control insect, pest such as Neem oil and pyrethrum etc.
4. Organic farming loses yield due to lack of insufficient control system, weed suppression, disease and pest resistance traits in cultivar such as late blight in potato, powdery mildew in pea etc.
5. Organic crop ideotype: although the organic sector is receiving advantage from organic plant breeding through breeding efforts, all varieties which are going under trial, are not fit for all requirements. The organic system approach requires that all varieties which are developed through organic plant breeding must adopt the given organic environment rather than the conventional environment to the variety. The ideotype for organic conditions should have the features e.g., wider adaptation, maintain or improve the soil fertility through application of organic inputs, better root system, to take benefit from soil micro-organisms, suppressing ability of weeds, maintain soil and crop health, good quality product and high yield stability
6. Loss of genetic resources: many farmers continuing use of modern high yielding varieties in place of landraces, transgenic and hybrids. Due to lack of systemic collection of land races small or no of variety/gene pool/ germplasm has been conserved in seed gene bank for organic plant breeding.

Pest, Disease and Weed management-

Use of synthetic/chemical pesticides, fungicides and weedicides is prohibited. Natural enemies shall be encouraged and protected. (for e.g. raising trees in the farm attracts birds

which kills pests of the crops, nest construction etc.) Products collected from the local farm, animals, plants and micro organisms and prepared at the farm are allowed for control of pests and diseases. (eg. Neem Seed Kernel Extract, cow urine spray). Use of genetically engineered organisms and products are prohibited for controlling pests and diseases. Similarly, use of synthetic growth regulators is not permitted. Slash weeding is to be done between the plants. Weeds under the base of the plants shall be cleaned and put as mulch around the plant base. The weeded materials should be applied as mulch in the ground itself. The products that are permitted for control of pest & diseases are Neem oil and other neem preparations like Neem Seed Kernel Extract, Chromatic traps, Mechanical traps, Pheromone traps, and Plant based repellents, Soft soap and clay. The following products shall be used when they are absolutely necessary and taking environmental impact into consideration. The certification agency shall be consulted before using these inputs.

- Bordeaux mixture
- Plant & animal preparations e.g. Cow urine spray, Garlic extract, Chilli extract
- Light mineral oils e.g. Kerosene

Certification process for the organic products-

Certification of organic farms is required to satisfy the consumers that the produce is totally organic. Certification agency conducts the inspection that minimum requirements prescribed for organic agriculture is fully met and issues certificate. The producer makes contact with certifying agency. Certification agency provides information on standards, fees, application, inspection, certification and appeal procedures. The producer then submits application along with field history, farm map, record keeping system etc. Then the contract indicating scope, obligation, inspection and certification, sanction and appeals, duration, fee structure is executed. Then the Inspector of agency comes and carries out inspection. The Inspector gives inspection report with his recommendation to the agency, then the agency issues approval or denial of certificate. Certificate is given for current year's harvest only and hence annual certification is required.

In India, there are two accreditation systems for authorizing Certification and Inspection agencies for organic certification. National Programme on organic Production (NPOP) promoted by Ministry of Commerce is the core programme which governs and defines the

standards and implementing procedures. National Accreditation Body (NAB) is the apex decision making body. Certification and Inspection agencies accredited by NAB are authorized to undertake certification process. The NPOP notified under FTDR act and controlled by Agricultural Processed Foods Export Development Authority (APEDA) looks after the requirement of export while NPOP notified under APGMC act and controlled by Agriculture Marketing Advisor, Directorate of Marketing and Inspection looks after domestic certification. Currently 20 certification agencies have been authorized to undertake certification process. Details of the system are available at www.apeda.com/npop. In 2006, India's organic certification process under NPOP has been granted equivalence with European Union and Switzerland. It has also been recognized for conformity assessment by USDA's NOP. NPOF is being implemented by National Centre of Organic Farming at Ghaziabad and its eight Regional Centres at Bangalore, Bhubaneshwar, Panchkula, Ghaziabad, Imphal, Jabalpur, Nagpur and Patna. Besides working for realisation of targets under NPOF, NCOF and RCOFs are also performing specific roles in promotion of organic farming.

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